



XXX School of Underground Mining
Session – Methane in the Context of the Transition of the Coal Sector
Kraków, September 27th 2021



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The Orzesze-1 stratigraphic well
– new findings about coalbed methane in the deep structures of the
Upper Silesian Coal Basin

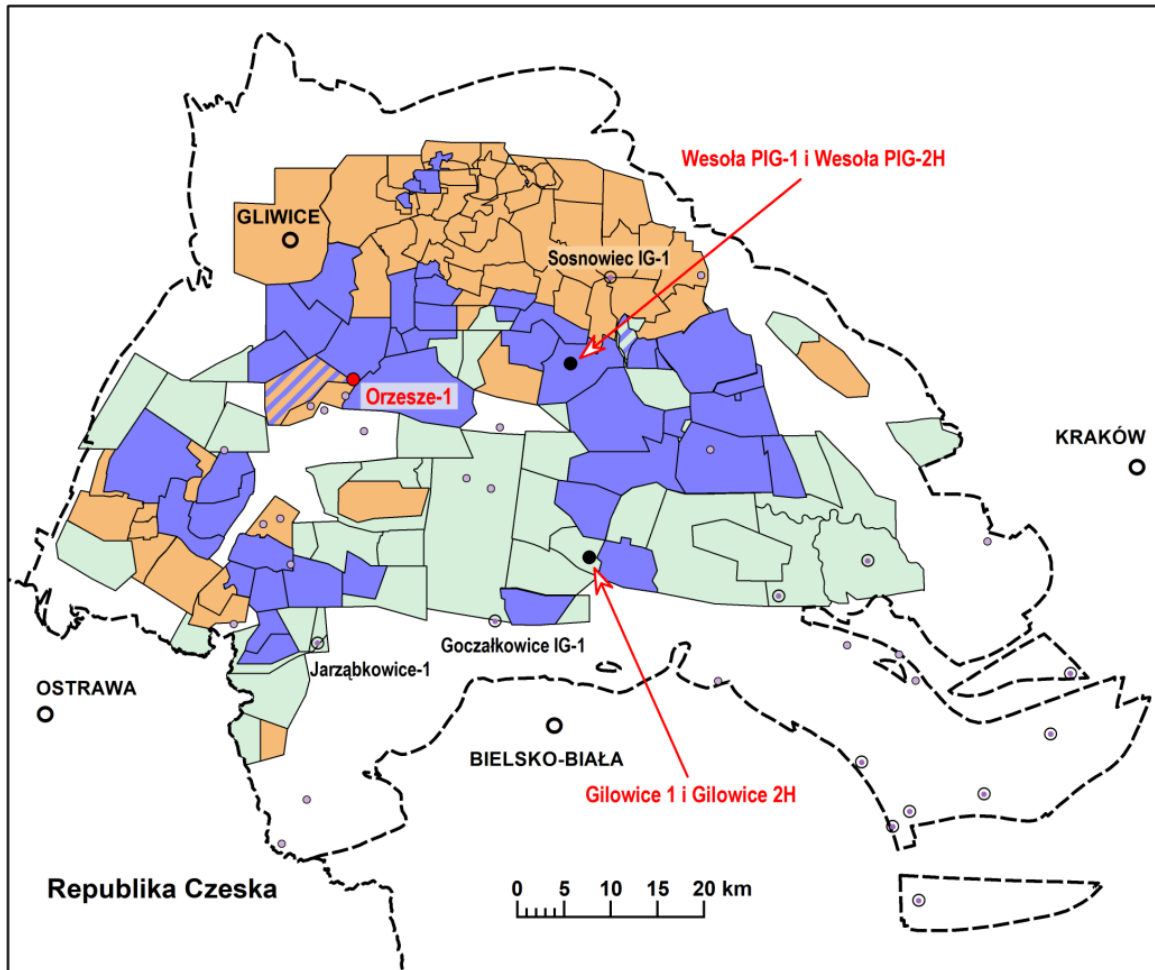


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1921 - 2021



Orzesze-1 Stratigraphic Test Well

Well location as related to historical deep boreholes in the Upper Silesian Coal Basin



Explanations:

- Orzesze-1 Stratigraphic Test Well
- CBM intersected wells
- Wells with TD from 2000 to 3000 m
- Wells with TD greater than 3000 m
- Developed coal fields
- Abandoned coal fields
- Undeveloped coal fields
- Coal fields planned to be developed
- - - Extent of the USCB

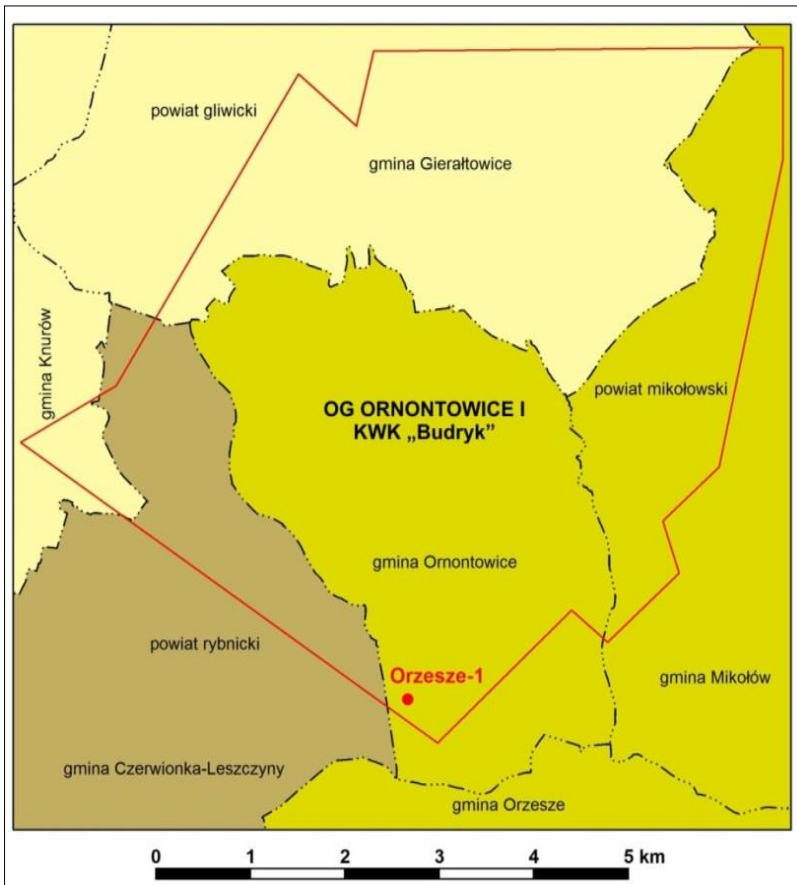
Geological and mining data coverage:

- 145 hard coal fields
- over 12000 boreholes (excluding in-mine boreholes)
- 1274 wells deeper than 1000 m
- 34 wells deeper than 2000 m
- 3 wells deeper than 3000 m (without the NE part of the basin)

Orzesze-1 Stratigraphic Test Well – Basic Details

Drilling purpose:

- geological investigations in the area of maximum subsidence (depocenter) of the USCB, to the base of Carboniferous coal-bearing sediments
- examining possible occurrence of BCSG (*basin centered gas system*) and CBM (*coalbed methane*) accumulations



Location:

- Orontowice, Mikołów county, Silesia voivodship
- „Budryk” Coal Mine (JSW SA), „Budryk” hard coal field, „Orontowice I” mining area;
- Central part of the Main Syncline of the USCB

Spud and completion date of drilling:

06.10.2019 – 07.03.2020

Total depth: 3710 m

Coring intervals:

800,0–1099,0; 1154,0–1822,0; 1900,0–2846,0;
2940,0–2960,0; 3050,0–3118,0; 3451,0–3486,0; 3707,0–
3709,7

Total cored: 2037 m

Orzesze-1 Stratigraphic Test Well



Legal basis:

Work Program for geological investigations of the Upper Silesian Coal Basin depocenter as well as examining possible occurrence of coalbed methane and basin center gas system accumulations – vicinity of Orzesze, the Orzesze-1 stratigraphic test well.

Investor: Polish Oil and Gas Company (PGNiG)

Drilling contractor: Exalo Drilling

Professional support: Polish Geological Institute – NRI

Field, laboratory and testing work:

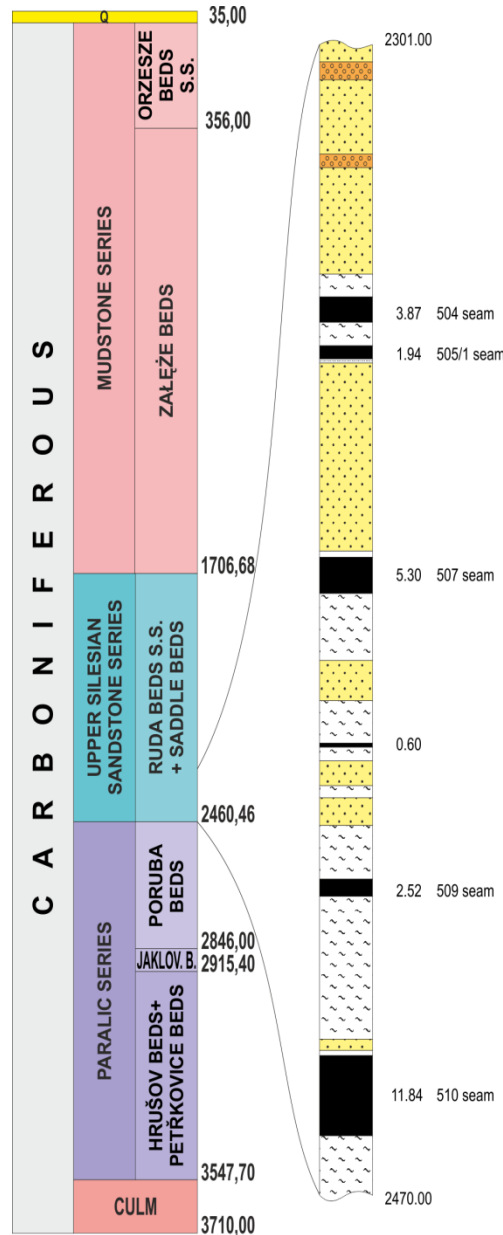
- Polish Oil and Gas Company (PGNiG)
- Polish Geological Institute – NRI
- Oil and Gas Institute – NRI (INiG)
- Geokrak Sp. z o.o., Kraków
- Maxi-Geolab Sp. z o.o.
- Centralne Laboratorium Pomiarowo-Badawcze, Jastrzębie-Zdrój
- Geofizyka Toruń Sp. z o.o.

Orzesze-1 Stratigraphic Test Well – Stratigraphy

Stratigraphy of Carboniferous in the USCB

EPOKA SERIES	WIEK STAGE	JEDNOSTKI LITOSTRATYGRAFICZNE LITHOSTRATIGRAPHIC UNITS		
PENSYLVANIAN PENNSYLVANIAN	Gżel Gzhelian + Kazimow Kasimovian (?)	ARKOZA KWACZALSKA KWACZALAARCOSE		
	Moskow Moscovian	WESTFALIAN WESTPHALIAN	KRAKOWSKA SERIA PIASKOWCOWA Krakow Sandstone Series warstwy libiąskie Libiąż Beds warstwy łaziskie s.l. Łaziska Beds s.l. warstwy orzeskie s.s. Orzesze Beds s.s. warstwy załęskie Załęże Beds	
		Baszkir Bashkirian	GÓRNOŚLĄSKA SERIA PIASKOWCOWA Upper Silesian Sandstone Series	warstwy rudzkie s.s. Ruda Beds s.s. warstwy siodłowe Saddle Beds warstwy jejkowickie Jejkowice Beds
			PARALICZNA SERIA Paralic Series	warstwy porębskie Poruba Beds warstwy grodzieckie* Grodziec Beds warstwy jankowickie Jankowice Beds warstwy florowskie* Flora Beds warstwy gruszowskie Hrušov Beds warstwy sarnowskie* Sarnów Beds warstwy pietrkowickie Petrkovice Beds
		Wizen Visean	KULM FLYSCH ASSOCIATION	WARSTWY MALINOWICKIE Malinowice Beds WARSTWY ZAŁASKIE Załas Beds
			górne upper dolne lower	

Carboniferous section penetrated by Orzesze-1 well



Stratigraphy of the Orzesze-1 well section

00,00–35,00	Quaternary
<u>Carboniferous</u>	
35,00–1706,78	Mudstone Series (Westphalian A+B)
356,00	– Orzesze Beds s.s. (Westphalian B)
1706,78	– Załęże Beds (Westphalian A)
1706,78–2460,46	Upper Silesian Sandstone Series (Namurian B+C)
	– Ruda Beds s.s. + Saddle Beds
2460,46–3547,70(?)	Paralic Series (Namurian A)
2846,00	– Poruba Beds
2915,40(?)	– Jaklovec Beds
3547,70(?)	– Hrušov Beds + Petrkovice Beds
3547,70(?)–3710,00	Malinowice Beds (Namurian A)
	– culm

Orzesze 1 Stratigraphic Test well – Scope of Work

Field and laboratory work as well as desk studies:

- Mudlogging services
- Environmental investigations (soil, water and soil air)
- Well logging (broad scope with VSP)
- Visual description and laboratory tests of core and cutting samples
- Reporting work

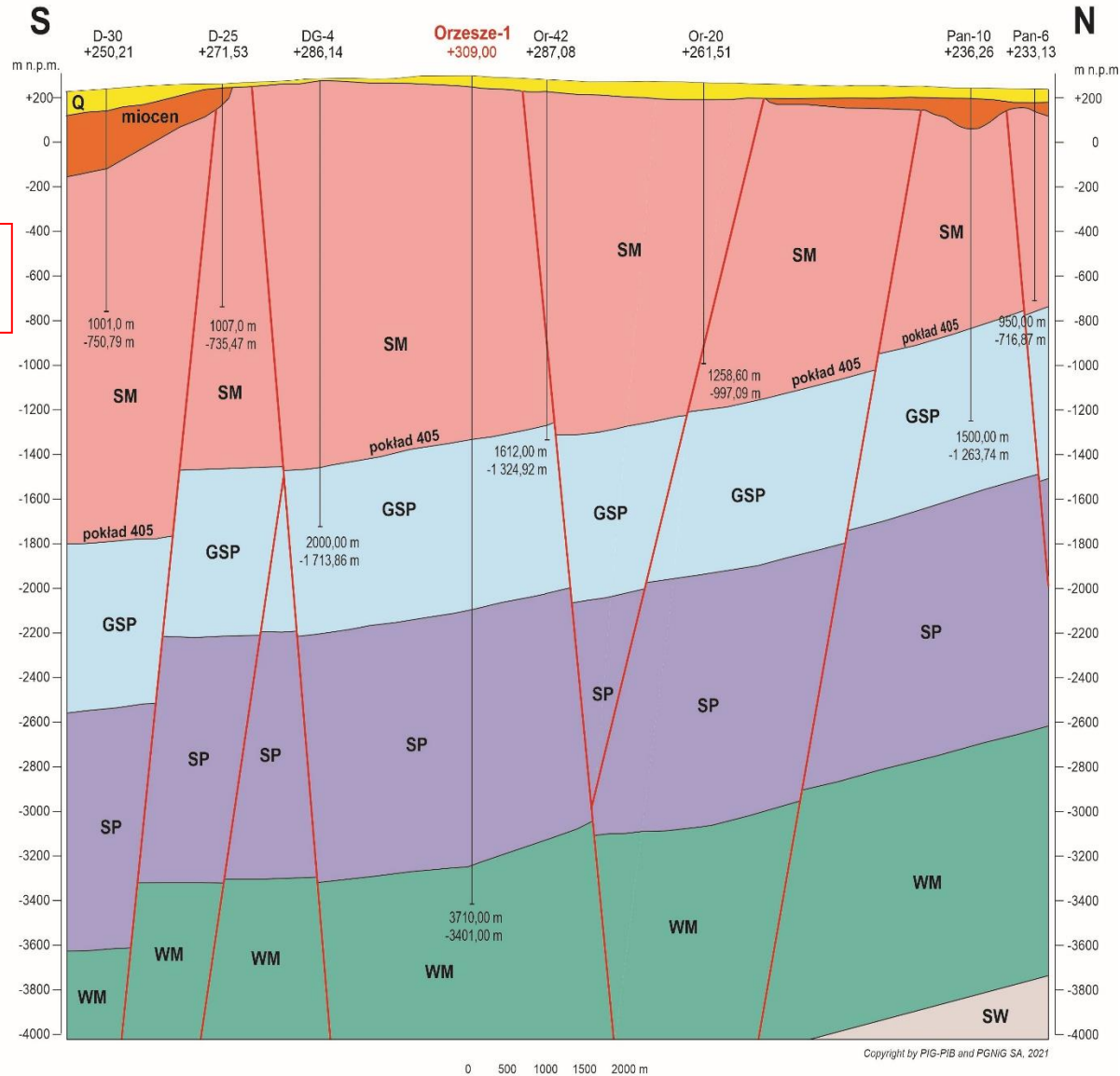
Contribution of PGI-NRI:

1. Desktop studies prior to drilling (location and setting of the well)
2. Special tests of core samples (including subcontractors, mainly INiG)
3. Reporting work (in cooperation with PGNiG)

Legal basis:

- *Contract for professional cooperation in conducting Research Project of drilling the Orzesze-1 deep stratigraphic test well*
- *Contract for providing special examination services while drilling of the Orzesze-1 well.*

Working personnel – 25 specialists from: Upper Silesian Branch, Department of Regional Geology, Lower Silesian Branch, Chemical Laboratory, Holy Cross Branch



Orzesze-1 Stratigraphic Test Well – Core Analyses



Core scanning

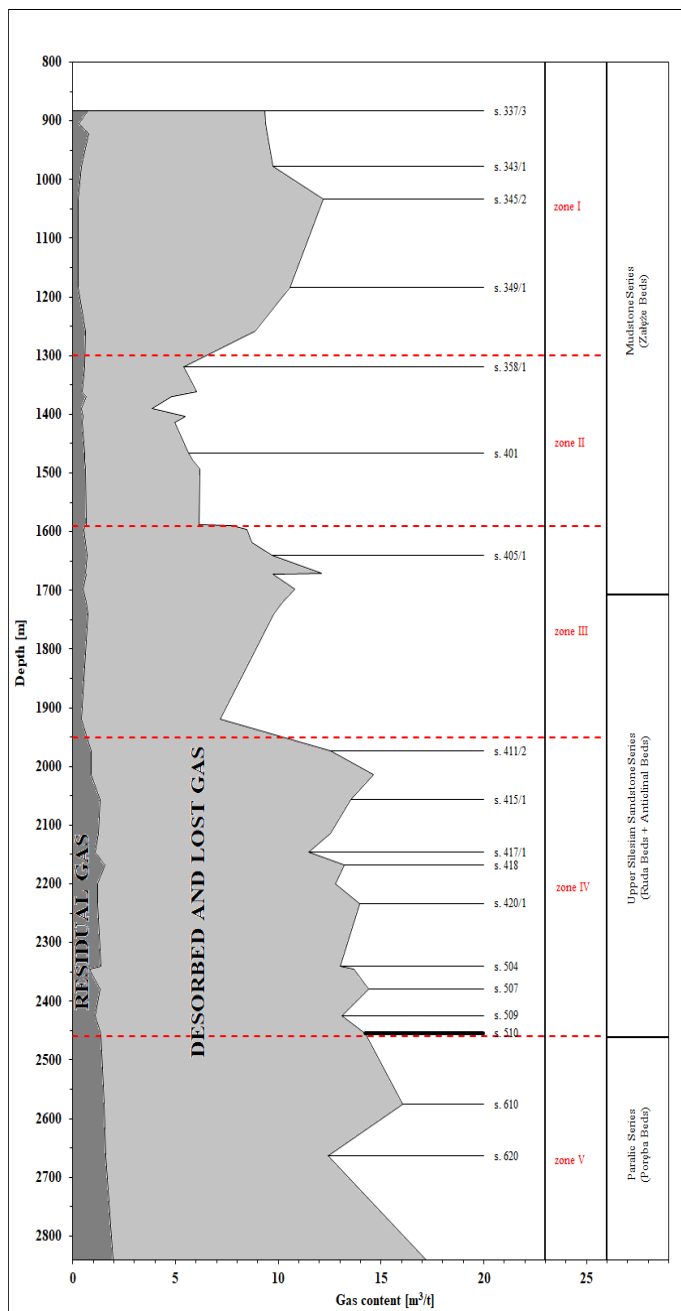
Comprehensive testing of coal and clastic rock samples, including:

- Gas content and petrology of coal and shale rich in organic matter
- Chemical-technological analyses of coal for coal quality assessment
- Reservoir properties of coal and clastic rocks (including porosity and permeability)
- Petrophysical properties of clastic rocks (NMR, spectral gamma logger, electrical properties determination, fracability evaluation of shale)
- Organic geochemistry analysis (TOC, Rock Eval pyrolysis, elemental analysis of Kerogen)
- Mineralogy and petrography of sedimentary rocks, including X-ray diffraction (XRD)
- Geomechanical properties of coal and clastic rocks
- Biostratigraphic analysis of Carboniferous (macrofauna and spores)
- Chemostratigraphic analysis and correlation based on XRF investigations of cutting and core samples
- Core description, sedimentological and tectonic analysis of core
- Core scanning in planar and rotary modes, using an optical core scanner

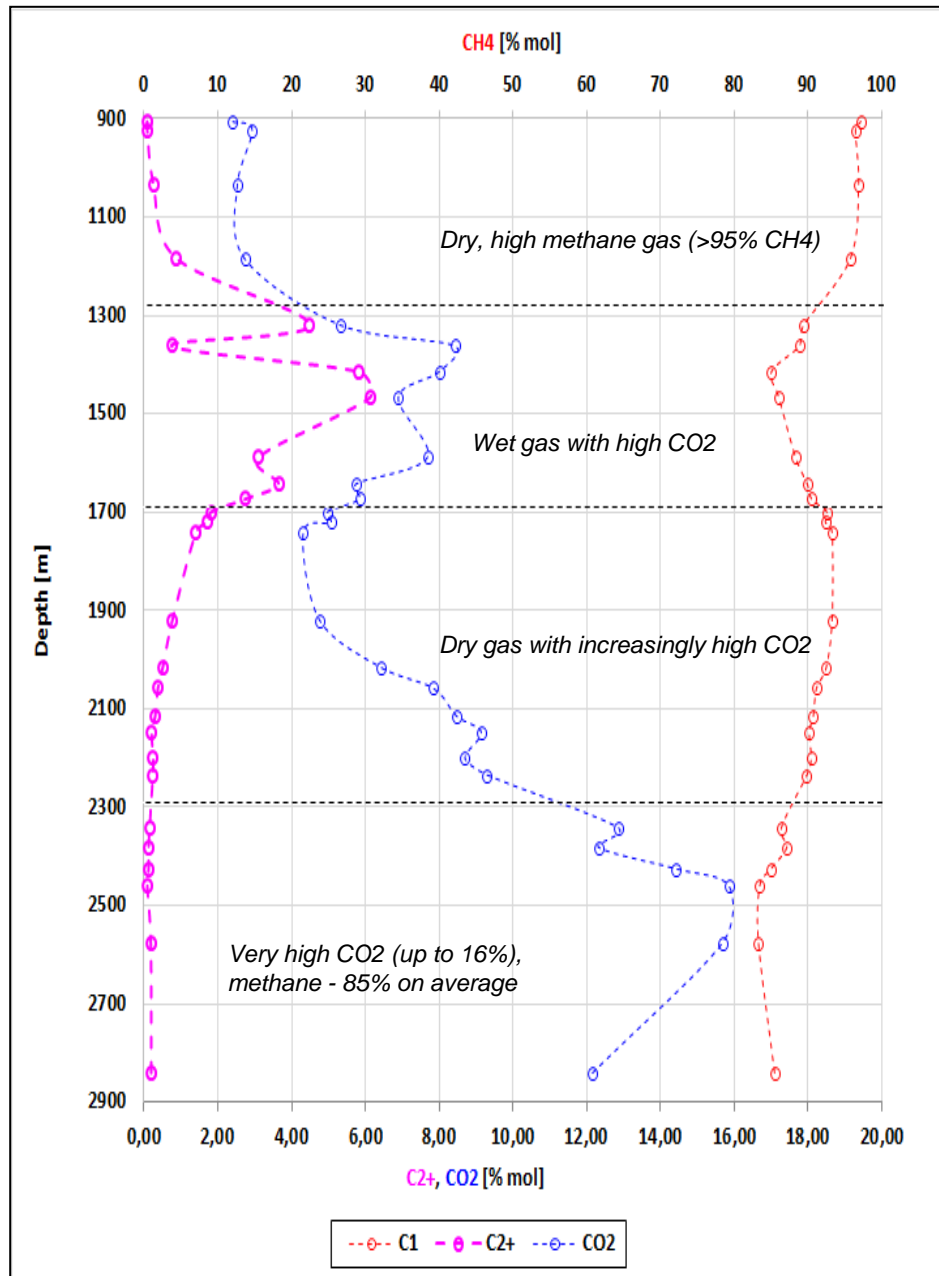
**Chmielnik
PGNiG core storage facilities**



Orzesze-1 Stratigraphic Test Well – Gas Content of Coal



Orzesze-1 Stratigraphic Test Well – CBM Gas Composition



Orzesze-1 Stratigraphic Test Well – summary



1. Orzesze-1 well is the deepest borehole in the Upper Silesian Coal Basin within the area which is not overlain by the Carpathian overthrust.
2. The well was planned as an experimental drilling with the following objectives:
 - geological investigations in the depocenter of the USCB, to the base of Carboniferous coal-bearing sediments
 - evaluation of CBM conditions and determination of coalbed gas content in the Carboniferous coal-bearing sequence
 - examining possible occurrence of basin center gas system accumulations in deep sediments of the Paralic Series.
3. The occurrence of the Upper Silesian Sandstone Series with high content of coal, including (12 meters thick) 510 coal seam, was confirmed for the first time in the central part of the USCB.
4. High gas content of coal seams was also confirmed, while the zonality of coalbed gas content vertical profile was clearly recorded for the first time in the Carboniferous sequence. Apart from the well-known zone of high gas content of coalbeds (with peak gas content values at 1250-1300 m), which is followed by a decrease in gas content with depth, occurrence of the second zone of high gas content was observed beneath the depth of 2000 m.
5. BCGS potential was not confirmed. Elevated gas peaks – observed during the drilling – were exclusively associated with coal seams. Methane gas peaks in sandstones of the Paralic Series were very low, while petrophysical analyses of sandstone revealed poor reservoir properties.



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**Thank you for your
attention**